

IN55E-0278 - How Discipline-Oriented DAACs Collaborate to Support Interdisciplinary Earth Science



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NASA Earth Science Data Information System (ESDIS)

PRESENTED AT:

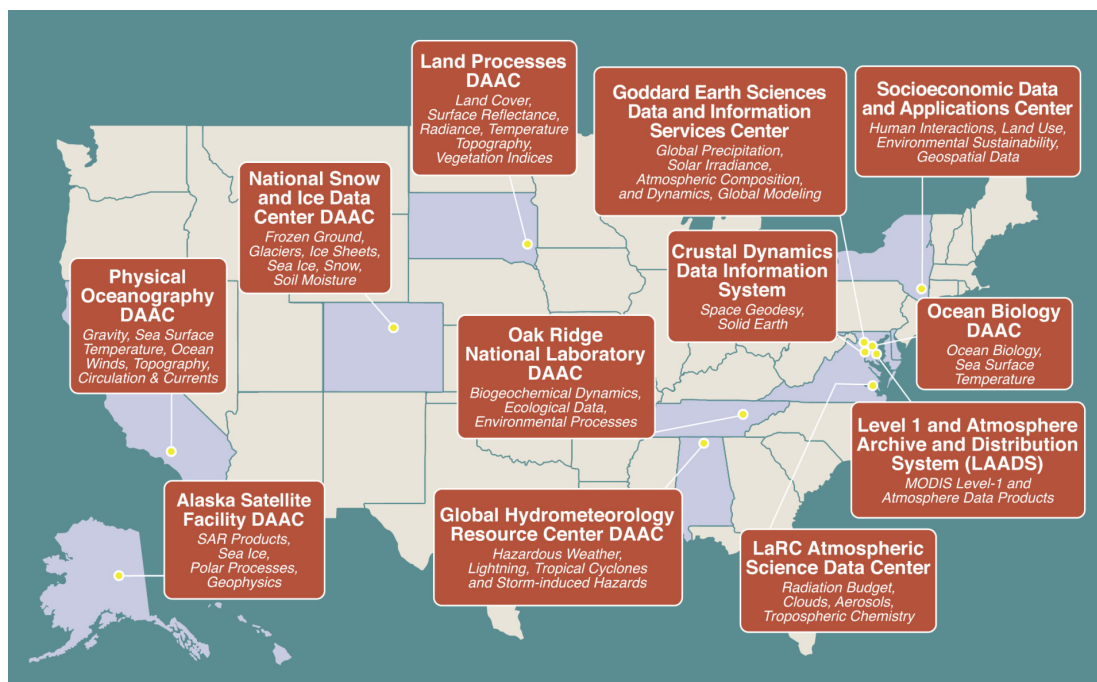


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DAACS ARE DISCIPLINE EXPERTS

For more than 25 years, the Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAACs) have served NASA's science user community. Each DAAC has a discipline focus with expertise built on years of experience working with science teams and managing data for these discipline communities.



Each DAAC is aligned with a NASA Headquarters Program scientist and an active User Working Group made up of discipline scientists who advise the DAAC on how to improve NASA's data resources for their community. Over the years, these groups have contributed to solid improvements in NASA's Earth data collections and services ensuring that discipline-specific data users have the data, tools, and services they need to study the Earth and its processes.

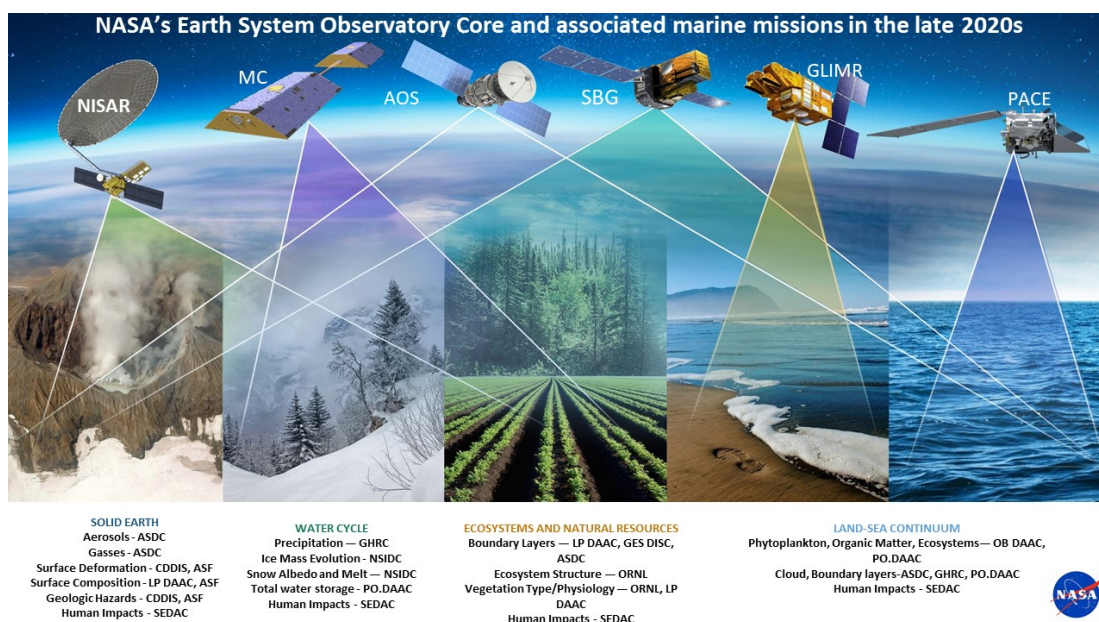
EARTH SYSTEMS OBSERVATORY (ESO) MULTIDISCIPLINARY MISSIONS

In the past, NASA missions were assigned to a DAAC based on discipline. When two or more DAACs were appropriate, other factors helped guide the decision. The assigned DAAC was responsible for communication with the science teams, ingest and archive of the data, and creating tools and services to facilitate data use by discipline communities. The data was made available to all users via the Earthdata website.

The new Earth Systems (NASA-ISRO SAR Mission (NISAR), Mass Change (MC), Atmosphere Observing System (AOS), Surface Biology and Geology (SBG), Geosynchronous Littoral Imaging and Monitoring Radiometer (GLIMR) and Plankton, Aerosol, Cloud, ocean Ecosystem (PACE)) have a multi-disciplinary focus. For example, SBG will include two sensors “*Hyperspectral imagery in the visible and shortwave infrared; multi- or hyperspectral imagery in the thermal IR*” which will enable research and applications in at least five focus areas:

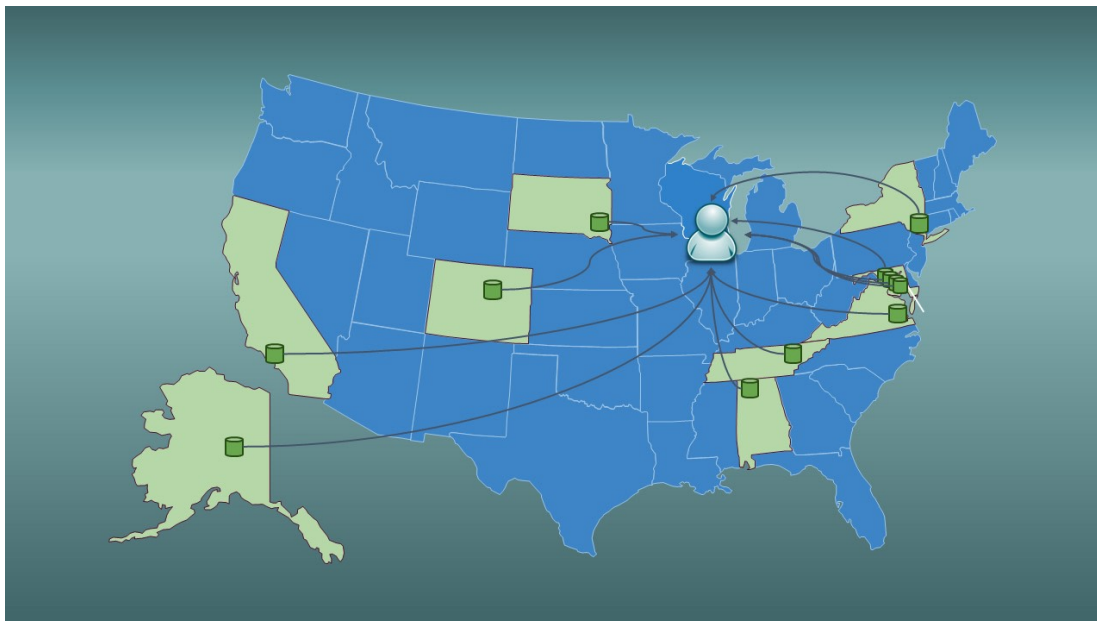
- Terrestrial and aquatic ecosystems
- Hydrology
- Weather
- Climate
- Solid Earth

Multidisciplinary sensors require a multidisciplinary approach to data stewardship.



MOVE TO THE CLOUD ALLOWS A COLLABORATIVE DAAC APPROACH

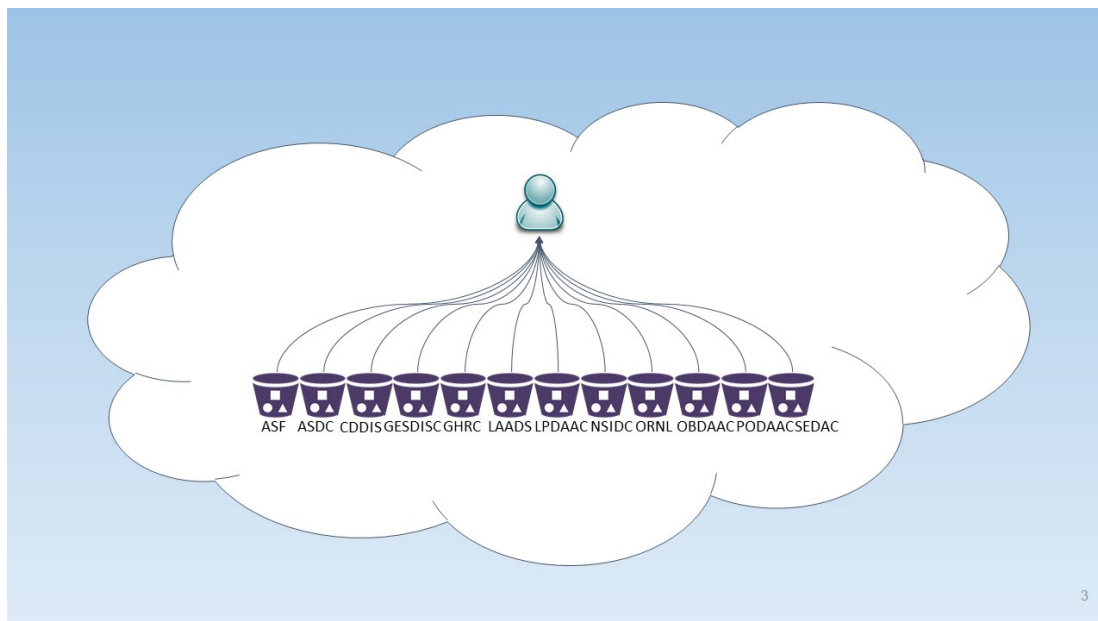
Historically, NASA's Earthscience data has been archived in on-premise servers located at the DAACs. Multidisciplinary users might need to visit several DAACs to find needed data.



The launch of upcoming high-data-volume missions such as the Surface Water and Ocean Topography (SWOT) and NASA-Indian Space Research Organisation Synthetic Aperture Radar (NISAR) missions is projected to increase the volume of data in the EOSDIS collection to more than 250 petabytes by 2025.

As the volume of data in NASA's Earth Observing System Data and Information System (EOSDIS) archive grows, so does the need for more flexible and scalable data access and management technologies. The EOSDIS DAACs are in the process of moving data holdings into commercial cloud archives. While the move to the Earthdata Cloud will not affect users who prefer to download data to their own computers, the cloud offers new opportunities for open science, collaborative work, and the application of large-scale analytics. All new missions, including ESO missions, will be archived directly in the Earthdata Cloud.

Users will still have the ability to download data from any DAAC directly to their computers, but the common environment will enable new services and increase opportunities for DAAC Collaboration as data is available to all DAACs.



This approach will enable NASA data use by new communities and expand the DAACs' role as Science Enabling Centers.

TEST CASE: AVIRIS

The Airborne Visible InfraRed Imaging Spectrometer (AVIRIS) and AVIRIS Next Generation (NG) are hyperspectral imaging spectrometers used to make airborne passive reflectance measurements (~400 to ~2500 nm). AVIRIS and AVIRIS-NG data are used to identify, measure, and monitor constituents of the Earth's surface and atmosphere based on molecular absorption and particle scattering signatures. The data can be applied to studies in the fields of oceanography, environmental science, snow hydrology, geology, volcanology, soil and land management, atmospheric and aerosol studies, biomass, carbon monitoring, agriculture, limnology and more. Because the data is relevant to so many disciplines, the best DAAC to archive AVIRIS and AVIRIS-NG data was not a clear choice. The EOSDIS move to the Earthdata Cloud offered the opportunity to try a collaborative DAAC model.

The Oak Ridge National Laboratory (ORNL) DAAC for Biogeochemical Dynamics was selected as the Primary DAAC for AVIRIS and AVIRIS-NG based on the DAAC's extensive experience with similar airborne data. As the primary DAAC, ORNL DAAC will:

- Work with the AVIRIS science team to ensure data quality
- Augment metadata to enhance discoverability and data integration across missions/instruments
- Develop comprehensive documentation
- Publish data directly to the Earthdata Cloud
- Develop and publish example Jupyter notebooks and other Learning Resources to support scripting and geospatial information system (GIS) usage
- And work with additional DAACs to support tool integration

Secondary DAACs, including the Land Processes DAAC (LP DAAC) and the Physical Oceanography DAAC (PO.DAAC), will develop Jupyter notebooks showcasing the use of the AVIRIS data for their specific user communities and include AVIRIS in their DAAC airborne data tools. This will expand the use of AVIRIS data to new communities.



TECHNOLOGY THAT ENABLES OPEN SCIENCE ACROSS DISCIPLINES

NASA's discipline-oriented DAACs allow users to directly interact with experts on data in their field. However, the DAACs also support interdisciplinary users with a collaborative culture and technology that empowers the open sharing of data, information, and knowledge within the scientific community and the wider public to accelerate scientific research and understanding.

DAAC technology that enables open science across disciplines includes:

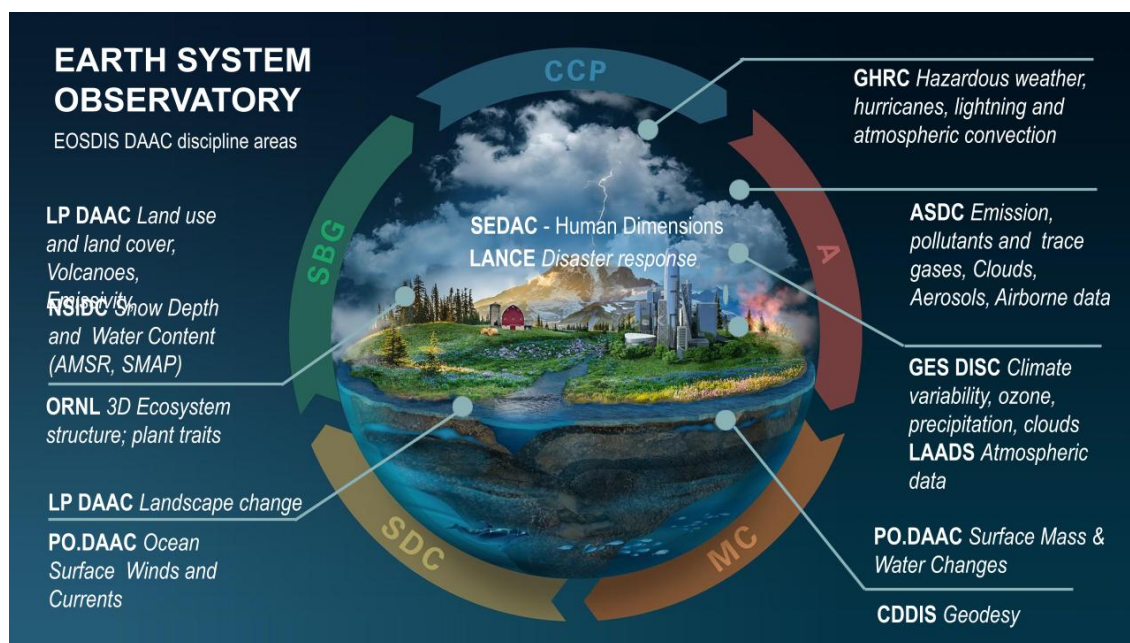
- Personal analysis tools like Jupyter Notebooks that can be customized within a users environment
- Online tools like Geospatial Interactive Online Visualization and Analysis Infrastructure (Giovanni) and Application for Extracting and Exploring Analysis Ready Sample (AppEEARS) that can perform data evaluation and assessment
- API interfaces that can be used across disciplines (e.g. Common Metadata Repository for finding data)
- ESRI StoryMaps allow collaboration on topics along with data assimilation software
- Earthdata Forum allows users to ask questions and find answers to SMEs across NASA Earth Science.

DAAC also collaborate with each other to ensure a consistent user experience across EOSDIS:

- Prepare perspectives on data stewardship. The DAACs are the original developers of "open" availability of NASA Earth Science data
- Development of Earth Science metadata to ensure consistent metadata quality while preserving discipline-specific approaches to attributes
- Development of standards and standards processes – e.g. the development of the structure of file format in use across Earth Science and its uptake by disciplines is due to collaboration across DAACs
- Metrics and how to characterize data growth and distribution is based on a collaborative approach enacted by DAACs
- Use of DOIs and landing page structures was developed by DAAC committee

As more data moves to the Earthdata cloud, EOSDIS will continue to develop services to promote open, collaborative science. The future of interdisciplinary collaboration includes:

- Cumulus: A single software system to manage data collection in the cloud:
- Earthdata Pub: Updated processes that reflect a common approach to data accession
- OpenScapes and Cloud Primer: A common approach to training new users to take advantage of the Cloud
- Common Metadata Repository: A multi-faceted metadata update for a Cloud common location
- Harmony: A common services environment to support multi-discipline data



ABSTRACT

The Earth system is made of multiple complex subsystems. While scientists tend to specialize in single subsystems or even portions of a subsystem, to fully understand the physical, chemical and biological processes occurring on the Earth, we must understand how these systems interact. Thus, scientists need to be able to expand beyond their chosen field and collaborate across disciplines. The NASA Earth Observing System Data and Information System (EOSDIS) is focusing on new capabilities to make interdisciplinary science easier.

The EOSDIS DAACS are responsible for archiving and distributing NASA's rapidly growing collection of satellite, airborne and field data. Like the scientists they serve, the DAACs are discipline oriented. This has many advantages. Scientists are able to interact with experts on data in their domain and receive data appropriate for their research. However, discipline-oriented services may be confusing to cross-disciplinary users who may not know how to get started. Fortunately, collaboration across scientific communities is a specialty of the DAACs who support interdisciplinary users with a collaborative culture and technology that empowers the open sharing of data, information, and knowledge within the scientific community and the wider public to accelerate scientific research and understanding.

This presentation will discuss the capabilities of a discipline-oriented approach to support future Earth science goals including those of Open Science and cross-disciplinary collaboration.